Remarks

Claims 1-11 are pending.

Rejection of Claims under 35 U.S.C. § 103

Claims 1-11 remain rejected under 35 U.S.C. § 103(a) as being unpatentable over Halle et al., "Fast Computer Graphics Rendering for Full Parallax Spatial Displays" (Halle) in view of Dehmlow et al., U.S. Patent No. 5,999,187 (Dehmlow). The applicants respectfully traverse these rejections.

Halle and Dehmlow taken alone or in combination neither teach nor suggest a computer-implemented method of rendering data for producing a full parallax autostereoscopic display of a digital scene including:

> . . . for each image element, determining a distance between said eyepoint and said near clipping plane that would avoid near clipping of said scene, thereby determining a set of near clipping plane distances;
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> positioning said camera frustra along a z axis in accordance with one or more of said near clipping plane distances;

as required by independent claim 1 and generally required by independent claims 10 and 11. Regarding both limitations, the Examiner states:

> **Dehmlow et al.**, however, provide a teaching of for each image element determining a distance between an eyepoint and said near clipping plane that would avoid near clipping of said scene, thereby determining a set of near clipping plane distances; and
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> positioning said camera frustra along said z axis in accordance with one or more of said near clipping plane distances. See 340, 348, 352, and 354 in Fig. 3; view frustrum culling step 818 (and steps 818, 820, and 822) in Fig. 8; and 914, 916, 918, 920, 922, 924, etc. in Fig. 9. (Office Action of March 9, 2005, p. 3, ¶¶7-8, emphasis in original)

The applicants respectfully disagree.

As an initial matter, the applicants respectfully submit that the particular parts of the cited references that the Examiner has relied upon have not been designated as nearly as practicable, and the pertinence of each reference has not been clearly explained, both as required by 37 C.F.R. § 1.104(c)(2). For the two claimed operations, the Examiner merely refers to 13 reference characters in three figures, with no specificity as to which

items are alleged to teach or suggest the applicants' claim limitations. Nevertheless, the applicants have made every effort to respond to the rejections outlined by the Examiner.

None of the cited portions of Dehmlow teach or suggest the applicants' claim limitations. Regarding flow chart operations 340, 348, 352, and 354, Dehmlow states in relevant part:

> In a typical situation, simplified rendering is necessary only when the camera is moving, i.e., during a "fly-through" procedure. Thus, if the camera is not moving 340, the scene will be rendered in full detail 342. If the camera is in motion, (i.e., if the user is providing input via a mouse, joystick, etc., indicating the user's desire to move the view point or "virtual camera" the system will then determine whether it is time for a new frame 343. (Column 10, lines 27-34)
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> As noted below, view frustum culling 348 is used to define a set of cells that will be within the "cone" of visibility for a given virtual camera position and other cells are "culled out." This cell culling can be used whether simplified rendering 346 or full detail 342 is being performed. (Column 8, lines 25-29)
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> Once view frustum culling is performed 348 and it is known which cells need to be rendered, scene processing is used 352 to provide procedures intended to deliver the "best" (substantially most useful or pleasing) image possible with the available resources. In general, the scene is rendered 354 in slices from front to back. This spatial partitioning divides the work to be done, allows slice primitives to be sent to the graphics pipeline early in the processing sequence (i.e., drawing starts before the entire scene is processed), sets implicit priorities (i.e., the slices in front may be rendered in greater detail than those behind), and allows rendering progress to be monitored. A rendering slice is a set of cells that is processed and drawn together. (Column 12, line 66 to column 13, line 11)

Thus, the referenced operations simply describe basic operations for rendering a fly-through view, but there is no teaching or suggestion of the specifically claimed distance determination or camera positioning operations.

Regarding flow chart operations 818, 820, and 822, Dehmlow states in relevant part:

> As depicted in FIG. 8, after defining the planes that bound the view frustum 812, cells are identified which are at least partially inside the view frustum and are marked "on" 814. This analysis is, in one embodiment, performed at a single pre-defined octree hierarchy level, such as level 5. Those identified cells which are frustum boundary cells are recorded 816,

> and it is determined which frustum boundary plane intersects each boundary cell 818. In one embodiment, in order to determine if a cell is within the frustum, a plane/cell corner test is used. Preferably, the cell-in-volume test can be performed with no more than 12 inequalities. The test reveals if a point (the cell corner) is in front of or behind a plane. This test can be performed using a simple dot product and thus is relatively rapid and easy to execute. According to this test, if the corner of the cell closest to the plane (assuming the cell is in front of the plane) is selected for the test, the results can be extrapolated to determine if a cell is completely or possibly partially in front of a plane. To determine if a cell intersects a plane, these results are combined with a second test where the orientation is reversed. In this second test, the normal on the other side of the plane is used to establish the forward direction and a new cell corner is used. If either test reveals that a cell is in front of the plane, then the cell does not intersect the plane. If both tests indicate the cell is partially in front of the plane, then the cell intersects the plane. For cells close to the position of the virtual camera, an axis-aligned plane (roughly coplanar with the far clipping plane) is used to exclude cells directly behind the virtual camera position. (Column 11, lines 28-56)
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> The cells are sorted in order of distance from the virtual camera 820. As described below, scene processing is performed slice-wise. The slice planes can be defined in a number of fashions. In one embodiment slice planes are defined as parallel to the far clipping plane (i.e., the bounding plane of the view frustum). Sort distance can be calculated as the dot product over the norm. The position of the current slice plane is updated. The distance from the virtual camera to this plane is calculated 822. The slice planes are used to incrementally partition the scene so it can be processed one-slice-at-a-time in a front-to-back order. (Column 11, lines 57-67

Thus, the referenced operations generally describe the process of culling cells from a frustrum: (1) determining which cells intersect frustrum boundary planes (note that Dehmlow's cells are volumetric regions, such as cubes, used to represent objects, see columns 1 and 2); (2) sorting the identified cells in order according to distance from a virtual camera; and (3) calculating a distance between a virtual camera and a current slice plane. As noted above, slices are used for spatial partitioning or rendering work to be done. Although one of the cited operations in Dehmlow teaches calculation of a distance between a slice plane and "the virtual camera," this neither teaches nor suggests the specific operation of determining a distance between a camera eyepoint and a near clipping plane *that would avoid near clipping of said scene*, for each image element.

Regarding flow chart operations 914-924, Dehmlow states in relevant part:

> FIG. 9 depicts a scene processing algorithm according to in one embodiment of the present invention. At the beginning of the procedure a timer is started 912. The virtual camera position is updated 914 and the view frustum is defined 916. The view frustum culling is performed 918 (e.g., a depicted in FIG. 8) and the region-time-distribution table is consulted to set the current level of detail 920. A spatial extent of the parts in the scene is determined 922. This can be done in a number of fashions. In one embodiment, two boundaries are defined by planes parallel to the far clipping plane. In other embodiments, it may be desirable to calculate density or complexity maps for this purpose. The spacing between slice planes is determined 924. Proper spacing is useful to avoid excessive processing overhead. Preferably the spacing is based on the current LOD (920). For example, if octree hierarchy level 5 is currently being rendered, then the slice plane spacing is set based on the size of a level 5 cell. The current slice plane location is updated (based on a previous plane location and current spacing 926). The cells in front of the current slice plane that have not yet been rendered are identified 928. As noted above, the view frustum culling algorithm provides this list of cells. At this point, a prediction is performed to determine if the cells can be drawn at the current LOD within the time remaining for the current region 932. If not, the LOD is updated to a coarser representation 934. The prediction is based on the region-time-distribution table and the value of the timer 912. If the cells can be drawn at the current LOD, the cells are rendered 936. Rendering progress is checked and the current LOD will be updated if necessary 942. (Column 14, lines 10-40)

Here, Dehmlow describes a scene processing algorithm that includes the updating of slice plane locations and references the above-described frustum culling procedure. Again, the cited portion of Dehmlow fails to teach or suggest the claimed determining and positioning operations.

The applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness. In addition to the claim elements not taught or suggested by the cited references as described above, the Examiner has not shown that there is some suggestion or motivation to combine Halle and Dehmlow, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. Neither reference suggests such a combination, and the Examiner merely states:

> It would have been obvious . . . to have modified the teachings of **Halle et al.** such that the above-identified frustrum culling steps taught by **Dehmlow et al.** be implemented . . . for at least the purpose of optimizing said computer-implemented method of rendering data taught by **Halle et**

> **al.** (Office Action of March 9, 2005, p. 3, bottom to p. 4, top, emphasis in original)

As noted above, Dehmlow's frustrum culling technique does not teach or suggest the claim limitations. As for the "purpose of optimizing" to which the Examiner refers as motivation to combine the references, the applicants respectfully submit that the Examiner has failed to explain what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination, as required by, for example, *In re Rouffet,* 47 USPQ2d 1453 (Fed. Cir. 1998). In fact, the applicants respectfully submit that one having ordinary skill in the art would not combine the references because Dehmlow's technique is for fast real-time rendering of fly-throughs, and thus uses frustrum culling to reduce the amount of scene data used. Rather than optimizing Halle's technique, Dehmlow's teachings would further reduce the image quality (e.g., resolution) of the images rendered using Halle's technique.

Accordingly, the applicants respectfully submit that independent claims 1, 10, and 11 are allowable over Halle and Robertson taken alone or in combination. Claims 2-9 depend from independent claim 1 and are allowable for at least this reason.

In view of the amendments and remarks set forth herein, the application is believed to be in condition for allowance and a notice to that effect is solicited. Nonetheless, should any issues remain that might be subject to resolution through a telephonic interview, the examiner is requested to telephone the undersigned.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA, 22313-1450, on May 31, 2005.

Attorney for Applicant(s) — Date of Signature: 5/31/05

Respectfully submitted,

Marc R. Ascolese
Attorney for Applicant(s)
Reg. No. 42,268
512-439-5085
512-439-5099 (fax)